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U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

ATTORNEY'S DOCKET NUMBER

TRANSMITTAL LETTER TO THE UNITED STATES

66376-277-7

DESIGNATED/ELECTED OFFICE (DO/EO/US)

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR

CONCERNING A FILING UNDER 35 U.S.C. 371

10/049877

INTERNATIONAL APPLICATION NO.
PCT/AT00/00212

INTERNATIONAL FILING DATE
3 August 2000

PRIORITY DATE CLAIMED
19 August 1999

TITLE OF INVENTION

HEARING-PROTECTION DEVICE

APPLICANT(S) FOR DO/EO/US

RIBIC, Zlatan; SCHIESS, Hans-Rudolf

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (24) indicated below.
4. ☒ The US has been elected by the expiration of 19 months from the priority date (Article 31).
5. ☒ A copy of the International Application as filed (35 U.S.C. 371 (c) (2))
 - a. ☐ is attached hereto (required only if not communicated by the International Bureau).
 - b. ☒ has been communicated by the International Bureau.
 - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
 - a. ☒ is attached hereto.
 - b. ☐ has been previously submitted under 35 U.S.C. 154(d)(4).
7. ☐ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3))
 - a. ☐ are attached hereto (required only if not communicated by the International Bureau).
 - b. ☐ have been communicated by the International Bureau.
 - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
 - d. ☐ have not been made and will not be made.
8. ☐ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)).
10. ☐ An English language translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)).
11. ☒ A copy of the International Preliminary Examination Report (PCT/IPEA/409).
12. ☒ A copy of the International Search Report (PCT/ISA/210).

Items 13 to 20 below concern document(s) or information included:

13. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
14. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
15. ☒ A **FIRST** preliminary amendment.
16. ☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
17. ☐ A substitute specification.
18. ☐ A change of power of attorney and/or address letter.
19. ☐ A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825.
20. ☐ A second copy of the published international application under 35 U.S.C. 154(d)(4).
21. ☐ A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).
22. ☐ Certificate of Mailing by Express Mail
23. ☒ Other items or information:

Copy of WO 01/13840, dated 1 March 2001
Translation of International Search Report

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR 1.101) <div style="font-size: 24pt; font-weight: bold;">10/049877</div>	INTERNATIONAL APPLICATION NO. <div style="font-weight: bold;">PCT/AT00/00212</div>	ATTORNEY'S DOCKET NUMBER <div style="font-weight: bold;">66376-277-7</div>
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24. The following fees are submitted: BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) : <input type="checkbox"/> Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO \$1040.00 <input checked="" type="checkbox"/> International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO \$890.00 <input type="checkbox"/> International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO \$740.00 <input type="checkbox"/> International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4) \$710.00 <input type="checkbox"/> International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4) \$100.00 <div style="text-align: right; font-weight: bold;">ENTER APPROPRIATE BASIC FEE AMOUNT =</div>				CALCULATIONS PTO USE ONLY <div style="border: 1px solid black; height: 100px; width: 100%;"></div>																																																																													
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<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th style="width:15%;">CLAIMS</th> <th style="width:25%;">NUMBER FILED</th> <th style="width:25%;">NUMBER EXTRA</th> <th style="width:15%;">RATE</th> <th style="width:15%;"></th> <th style="width:10%;"></th> </tr> </thead> <tbody> <tr> <td>Total claims</td> <td>10 - 20 =</td> <td>0</td> <td>x \$18.00</td> <td>\$0.00</td> <td></td> </tr> <tr> <td>Independent claims</td> <td>1 - 3 =</td> <td>0</td> <td>x \$84.00</td> <td>\$0.00</td> <td></td> </tr> <tr> <td colspan="4">Multiple Dependent Claims (check if applicable). <input type="checkbox"/></td> <td>\$0.00</td> <td></td> </tr> <tr> <td colspan="4" style="text-align: right; font-weight: bold;">TOTAL OF ABOVE CALCULATIONS =</td> <td>\$890.00</td> <td></td> </tr> <tr> <td colspan="4" style="padding: 5px;"> <input checked="" type="checkbox"/> Applicant claims small entity status. See 37 CFR 1.27). The fees indicated above are reduced by 1/2. </td> <td>\$445.00</td> <td></td> </tr> <tr> <td colspan="4" style="text-align: right; font-weight: bold;">SUBTOTAL =</td> <td>\$445.00</td> <td></td> </tr> <tr> <td colspan="4" style="padding: 5px;"> Processing fee of \$130.00 for furnishing the English translation later than months from the earliest claimed priority date (37 CFR 1.492 (f)). <input type="checkbox"/> 20 <input type="checkbox"/> 30 + </td> <td>\$0.00</td> <td></td> </tr> <tr> <td colspan="4" style="text-align: right; font-weight: bold;">TOTAL NATIONAL FEE =</td> <td>\$445.00</td> <td></td> </tr> <tr> <td colspan="4" style="padding: 5px;"> Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) (check if applicable). <input type="checkbox"/> </td> <td>\$0.00</td> <td></td> </tr> <tr> <td colspan="4" style="text-align: right; font-weight: bold;">TOTAL FEES ENCLOSED =</td> <td>\$445.00</td> <td></td> </tr> <tr> <td colspan="4"></td> <td style="text-align: center;">Amount to be: refunded</td> <td style="text-align: center;">\$</td> </tr> <tr> <td colspan="4"></td> <td style="text-align: center;">charged</td> <td style="text-align: center;">\$</td> </tr> </tbody></table>				CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE			Total claims	10 - 20 =	0	x \$18.00	\$0.00		Independent claims	1 - 3 =	0	x \$84.00	\$0.00		Multiple Dependent Claims (check if applicable). <input type="checkbox"/>				\$0.00		TOTAL OF ABOVE CALCULATIONS =				\$890.00		<input checked="" type="checkbox"/> Applicant claims small entity status. See 37 CFR 1.27). The fees indicated above are reduced by 1/2.				\$445.00		SUBTOTAL =				\$445.00		Processing fee of \$130.00 for furnishing the English translation later than months from the earliest claimed priority date (37 CFR 1.492 (f)). <input type="checkbox"/> 20 <input type="checkbox"/> 30 +				\$0.00		TOTAL NATIONAL FEE =				\$445.00		Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) (check if applicable). <input type="checkbox"/>				\$0.00		TOTAL FEES ENCLOSED =				\$445.00						Amount to be: refunded	\$					charged	\$
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- a. ☐ A check in the amount of _____ to cover the above fees is enclosed.
- b. ☒ Please charge my Deposit Account No. 04-2223 in the amount of \$445.00 to cover the above fees. A duplicate copy of this sheet is enclosed.
- c. ☐ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. _____. A duplicate copy of this sheet is enclosed.
- d. ☐ Fees are to be charged to a credit card. **WARNING:** Information on this form may become public. **Credit card information should not be included on this form.** Provide credit card information and authorization on PTO-2038.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO: <div style="border: 1px solid black; padding: 5px;"> Richard H. Tushin DYKEMA GOSSETT PLLC Third Floor West, Franklin Square 1300 I Street, NW Washington, DC 20005-3306 (202) 906-8680 </div>	<div style="text-align: center;"> SIGNATURE </div> <div style="text-align: center;"> Richard H. Tushin NAME </div> <div style="text-align: center;"> <u>27,297</u> REGISTRATION NUMBER </div> <div style="text-align: center;"> <u>February 19, 2002</u> DATE </div>
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66376-277-7

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:)	PATENT
)	
Zlatan RIBIC et al.)	Group Art Unit: Unknown
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Serial No.: To be assigned)	Examiner: Unknown
)	
Filed: February 19, 2002)	
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HEARING-PROTECTION DEVICE)	
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PRELIMINARY AMENDMENT

Washington, D.C.
February 19, 2002

Honorable Director for Patents
Washington, D.C. 20231

Sir:

Concurrently with the U.S. national phase filing of this application,
please amend it as follows:

IN THE CLAIMS:

Cancel claims 1-8 and insert new claims 9-18.

--9. A hearing-protection device for damping sounds in a
frequency-selective manner, comprising

- a housing which can be inserted into the external auditory canal of a person;
- a transmission path for sounds having at least one chamber and at least one channel which opens into said chamber and which has a predetermined cross-section progress;

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- a movable element provided in said housing which can be set in a multitude of positions in each of which one the cross-sectional progress and the length of the channel is different.

10. A hearing-protection device as claimed in claim 9, wherein the movable element is arranged as a rotatable drum in which several different channels are provided, with the individual channels being covered or released by a fixed housing part depending on the respective position.

11. A hearing-protection device as claimed in claim 10, wherein the drum is arranged within the chamber.

12. A hearing-protection device as claimed in claim 9, wherein several parallel channels are provided which are covered or released by the movable element.

13. A hearing-protection device as claimed in claim 9, wherein the cross-sectional progress of the channel can be changed continuously.

14. A hearing-protection device as claimed in claim 9, wherein the used state the chamber is connected via a first channel with the auditory canal of the person and via a further channel with the ambient environment.

15. A hearing-protection device as claimed in claim 9, wherein the channel consists of three sections which are disposed one after the other, with the middle section having a smaller cross section than the other sections.

16. A hearing-protection device as claimed in claim 15, wherein several parallel channels are provided which substantially differ by the length of the middle section.

17. A hearing-protection device as claimed in claim 9, wherein a membrane is provided in the chamber transversally to the transmission path.

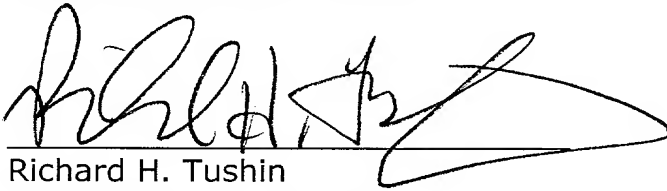
18. A hearing-protection device as claimed in claim 9, wherein several chambers are disposed in the transmission path.--

REMARKS

By this Preliminary Amendment claims 1-8 have been replaced by claims 9-18 which better conform with U.S. practice. Entry is requested.

Respectfully submitted,

DYKEMA GOSSETT PLLC



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JC13 Rec'd PCT/PTO 19 FEB 2002

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A hearing-protection device

The invention relates to a hearing-protection device for damping sounds in a frequency-selective manner, comprising a housing which can be inserted into the external auditory canal of a person, said housing containing a transmission path for sounds, consisting of at least one chamber and at least one channel with a predetermined cross-sectional course which opens into said chamber.

Effective hearing protection is gaining increasing importance due to rising noise levels. It is necessary in many cases, however, not only to ensure an effective protection of the human auditory organ, but also to maintain the person's ability to communicate. These requirements can be fulfilled by hearing-protection devices whose damping behavior is frequency-dependent. The damping behavior is chosen in such a way that the damping is low in the range of the frequencies which is important for the ability to understand speech, whereas the damping in the specific frequency range of noise will be chosen as high as possible. In many cases, however, the noise to be deadened is situated in the low-frequency range. In a number of cases, however, such as a tooth drill for example, high frequencies are concerned which need to be dampened in order to protect the ear. In the case of inadequate protection preliminary hearing losses will occur at first in which the threshold of hearing will regenerate again after a number of hours or days. In the case of continued noise exposition, a permanent hearing loss will occur which is also known as permanent threshold shift (PTS). Generally, a hearing loss occurs at first in the range between 3 kHz and 6 kHz. Subsequently, the hearing loss progresses in the range of high frequencies and only in the final phase also in the range of low frequencies. The healing of such hearing loss in the medical sense is not possible. That is why optimal hearing protection is of such importance.

A hearing-protection device is known from WO 91/11160 which is introduced into the ear and which is provided with one or several Helmholtz resonators. A Helmholtz resonator is a combination of a chamber forming an oscillation volume with a canal opening into said chamber. In the electro-technical analogy the

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canal, depending on its diameter, forms an inductivity or a resistance, whereas the chamber corresponds to a capacity. A frequency-selective damping can be achieved in this manner depending on the geometrical dimensions of the individual components. It has been proven, however, that a damping behavior which is well suited for a certain kind of noise exposition offers unsatisfactory results in other applications.

A hearing-protection apparatus is known from DE 42 17 043 A which is also arranged in the manner of a Helmholtz resonator. A protection from impulse-like noises with steep edges such as a bang is to be achieved with this kind of hearing-protection device in particular. The canal provided in the hearing-protection device can be closed by a suitable plug if need be, as a result of which the device can be changed over from selective damping to general damping. In this case the ability to understand speech is considerably impaired.

Various documents such as AU 56067 73 A, US 2,327,620 A or US 2,881,759 A describe hearing-protection devices in which a channel can be closed off by a valve or a seal in order to increase the damping accordingly. This allows choosing a low or high damping, as is required. A frequency-selective adjustment is not possible in this manner.

It is the object of the present invention to avoid such disadvantages and to improve a device of the kind mentioned above in such a way that an adjustment to the various stress situations can be performed. This means that the frequency characteristics of the damping should be changeable depending on the expected noise exposition without impairing the speech intelligibility in an overly manner.

It is provided for in accordance with the invention that a movable element is provided which can be set in a plurality of positions in which the cross-sectional progress and/or the length of the channel is different.

The relevant aspect in the invention is that as a result of the chamber and the channel a Helmholtz resonator is formed whose geometrical conditions can be adjusted to the purpose of application. It is relevant in this respect, however, to realize a relatively low damping in a frequency range of 1 kHz to 3 kHz in order

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to maintain speech intelligibility. Musicians may under certain circumstances have other frequency ranges in which a low damping is desirable. The damping of the other frequency ranges is set by changing the cross-sectional progress of the channel. The change of the cross-sectional progress means that the channel which generally is not provided with a uniform cross section in the longitudinal direction can be set in such a way that the best possible damping behavior of the entire apparatus is achieved. The important aspect is that the channel is not simply closed off, but is changed instead in its cross-sectional progress. Generally, the channel has different sections with different cross sections and the adjustment to the desired progress of the transmission function is carried out by changing the cross-sectional progress by changing the length of the individual sections for example.

In a first group of embodiments this changeability of the cross-sectional progress is given in such a way that several channels are provided, of which one each is activated while the others remain closed off and thus deactivated.

In a preferred embodiment the movable element is formed as a rotatable drum which is provided with several channels of different cross-sectional courses, with the individual channels being covered or released by a fixed part of the housing depending on the respective position. In every operating position of the movable drum one of the channels is released by a bore in the housing, while the others are covered. In order to realize especially specific frequency curves it is theoretically also possible to release two or more channels simultaneously and thus to connect the same in parallel.

A particularly compact arrangement is given when the drum is arranged within the chamber.

It may be provided for in an alternative embodiment of the invention that several parallel channels are provided which are covered or released by the movable element. A constructional simplification can thus be achieved in a number of cases.

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It is preferably provided for that several parallel channels are provided which are covered or released by the movable element.

In a further preferred embodiment of the invention, a continuous changeability of the cross-sectional progress or the length of the channel is provided for. In contrast to the above embodiments, the changeover is not made discretely between the individual channels, but the cross-sectional progress is changed continuously. A particularly fine adjustment is thus possible.

A particularly high damping effect is achieved when in the state of operation the chamber is connected via a first channel with the hearer's auditory canal and is connected via a further channel with the ambient environment.

A high effectiveness in combination with the possibility of cost-effective production can be achieved in such a way that the channel consists of three sections which are disposed behind one another, with the middle section having a smaller cross section than the other sections. It is especially appropriate when several parallel channels are provided which substantially differ from one another by the length of the middle section.

The above embodiments are primarily suitable to realize a controllable damping in the low-frequency range. A particularly effective control in the high-frequency range is possible when a membrane is provided in the chamber transversally to the transmission path. A suitable membrane will allow sound of low frequency to pass with a relatively constant damping, whereas in the range around the resonance frequency the damping is substantially controllable.

The invention is now explained in closer detail by reference to the embodiments shown in the drawings, wherein:

- Fig. 1 schematically shows a general hearing-protection device on which the invention is based;
- Fig. 2 shows a circuit diagram which describes the behavior of such a hearing-protection device;

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- Fig. 3 shows a schematic representation to explain how such a hearing-protection works;
- Fig. 4 shows a circuit diagram in connection with Fig. 3;
- Fig. 5 shows a diagram which shows the damping behavior of a device according to Fig. 3;
- Fig. 6 shows a further schematic representation of another embodiment;
- Fig. 7 shows a circuit diagram in connection with Fig. 6;
- Fig. 8 shows a diagram according to Fig. 5 for the embodiment according to Fig. 6;
- Fig. 9 shows a longitudinal sectional view through an embodiment of the present invention;
- Fig. 10 shows an axonometric exploded view of the embodiment according to Fig. 9;
- Fig. 11 shows a sectional view through a drum of the embodiment of Fig. 9;
- Figs. 11A, 11B, 11C, 11D and 11E show sectional views according to lines A-A, B-B, C-C, D-D and E-E, respectively, in Fig. 11;
- Fig. 12 shows a sectional view through a further embodiment of the invention;
- Fig. 13 shows an axonometric exploded view of the embodiment of Fig. 12;

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Fig. 14 shows a further embodiment of the invention in a sectional view;

Fig. 15 shows a front view of the embodiment of Fig. 14, and

Fig. 16 shows a partial representation of a further embodiment in a sectional view.

Fig. 1 shows the general arrangement of a hearing-protection device according to the state of the art. A housing 1 is arranged in its shape either in such a way that the device can be introduced into the external auditory canal or the housing is integrated in a respective matching part (not shown herein) in order to achieve the optimal adjustment to the respective anatomical conditions. The sound waves arriving according to the arrow 2 pass through a net 3 into a first chamber 4. The chamber 4 is closed off by a membrane 5 and the sound waves can leave the device into the interior of the ear through a further chamber 6 and an opening 7 according to the arrow 8. A suction volume 10 is connected with the further chamber 6 via channels 9 which influences the damping behavior of the device.

Fig. 2 shows an electric equivalent circuit diagram for the device of Fig. 1 which describes the behavior of said device. The sound wave corresponds to an alternating voltage source U which is applied to a capacity C_e which is representative of the ear. A first resistor R is connected in series to the capacity C_e which represents the acoustic impedance of the net 3. An inductivity L_m , a resistor R_m and a capacity C_m are connected in series which represent the membrane 5. The mass of the membrane is responsible for the inductivity, whereas the resistor R_m reflects the friction caused by membrane 5. The capacity C_m reflects the elasticity of the membrane 5.

A further inductivity L_r , a further resistor R_r , and a further capacity C_r are connected parallel to the capacity C_e of the ear. This corresponds to the channels 9 and the suction volume 10.

It is obvious that by making a respective choice of the geometrical conditions of the device of Fig. 1 and the kind of mass and the tension of membrane 7 it is

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possible to strongly influence the damping behavior of the device depending on the frequency. It is thus possible for example to set a substantially even damping behavior over a large frequency range. This damping behavior cannot be changed, however.

Fig. 3 shows the principal arrangement in a schematic view of an embodiment of the present invention which is substantially arranged as a low-pass filter in which the damping can be changed in the low-frequency range. In this case the following are provided behind one another: a channel 11 consisting of a first channel section 11a with a small cross section and a second channel section 11b with a larger cross section, a volume 12, a further channel 13 and a volume 14 which is representative of the ear. It has been noticed that a channel with a smaller diameter is acoustically representative of a resistance, whereas a channel with a larger cross section is rather representative of an inductivity. The reason for this is that friction dominates in channels with a smaller cross section, whereas the oscillation processes of the air play a role in larger cross sections. In the frequency range of interest one can assume a cross section of approx. 0.5 mm to 0.8 mm, beneath of which it is possible to observe a resistance behavior and above of which the inductivity dominates.

The nature of the invention is to change the length of the channel sections 11a and 11b in order to allow optimally adjusting the hearing-protection device to the respective needs.

Fig. 4 shows the respective circuit diagram in connection with Fig. 3. U again corresponds to the sound source, the resistor R_a corresponds to the first channel section 11a, the inductivity to the second channel section 11b, the capacity C_e to the volume 11, and the further inductivity to the further channel 13. C_e is again representative of the ear 14.

Fig. 5 schematically shows a damping diagram in which the initial sound level is entered over the frequency. Fig. 5 shows four curves 15a, 15b, 15c, 15d which represent the transmission behavior of the arrangement of Fig. 3 depending on the frequency. Curve 15a corresponds to an arrangement of Fig. 3 with a large length l of the first channel section 11a. The curve 15b corresponds to an

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arrangement according to Fig. 3 with a smaller 1, whereas the curves 15c and 15 correspond to an even shorter first channel section 11a.

Fig. 6 schematically shows another embodiment of the invention which is arranged as a filter which is controllable in the high-frequency range, comprising a channel 11, a membrane 126 and an ear volume 14. Fig. 7 shows the analogous circuit diagram, with R_s again corresponding to the resistance of channel 11 and the inductivity L_m , the capacity C_m and the resistor R_m again representing the electric analogon to the membrane 16. Fig. 8 again shows the curves 17a, 17b, 17c and 17d which correspond to the transmission behavior of the arrangement of Fig. 6 with a different length l of the channel 11. The curve 17a corresponds to the channel 11 with the largest length l , whereas curve 17d corresponds to channel 11 with the shortest length l .

Fig. 9 shows the constructional arrangement of a first embodiment of the invention. A housing 1 is closed with a lid 20. A drum 32 is rotatably held in the housing 1, which drum is pressed by a spring 22 against the lid 20.

Several bores are disposed in the axial direction in drum 21, one of which, namely the one forming channel 23a, is shown in Fig. 9. A bore 24 in the lid 20 connects channel 23 with the ambient environment. Further bores 25 in the face side of drum 21 are used to twist drum 21 with a respective tool (not shown). The space within the housing 1 and around the drum 21 forms a channel 26 into which channel 23a opens. A further channel 27 leads from chamber 26, which channel opens into the external auditory canal when the hearing-protection device is in use.

Fig. 10 shows an exploded view of the arrangement of the apparatus of Fig. 9 on a reduced scale. It can be seen that further channels 23b, 23c, 23d and a further channel (not shown) are arranged parallel to channel 23a.

Fig. 11 as well as Figs. 11A, 11B, 11C, 11D and 11E show the precise arrangement of the drum 21. Channel 23a in Fig. 11a is designed consistently with a comparably large diameter of 1.5 mm for example. The channel 23b which is parallel thereto comprises a middle channel section 23b' with a small diameter

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of 0.3 mm for example. The length of this channel section 23b is l_b . The channels 23c and 23d are arranged similar to channel 23b. The only difference is that the middle channel section 23c' or 23d' of reduced cross section are provided with different lengths l_c or l_d , respectively. The channel 23e of Fig. 11E comprises a channel section 23e' whose length l_e corresponds virtually to the entire length of channel 23e.

Fig. 12 shows a further embodiment of the invention in a longitudinal sectional view. An opening 28 is used for the outlet of the sound which has penetrated a membrane 29 which is disposed in a chamber 30 transversally to the direction of propagation of the sound. A drum 21 is provided upstream of the same, which drum is arranged in analogy to the drum of Figs. 9 to 11 with the difference that the spring 22 is disposed outside of the drum 21. Five parallel channels 23a to 23e are also arranged in drum 21 of Fig. 12, as is shown in the exploded view of Fig. 13. The sound waves enter the device in accordance with the invention through an opening 32 in a further lid 31. The membrane 29 is sealed and clamped by an O-ring 33 with respect to the housing 1 and the lid 20.

Fig. 14 shows an embodiment of the invention in which in a housing of the embodiments of Figs. 9 to 11 and Figs. 12 and 13 are mutually combined and are disposed parallel with respect to one another. A detailed description of the arrangement is therefore not necessary. Since the two drums 21 can be adjusted independently from one another there is a substantially independent controllability in the high-frequency and low-frequency ranges. This allows an optimal adjustment to difficult conditions. If a simultaneously forced damping is required both in the low-frequency as well as the extreme high-frequency range, it is possible, instead of a parallel connection, to provide a series connection of two or several individual devices.

Fig. 16 schematically shows an embodiment in which a continuous adjustability is given. A substantially helically arranged groove 35 is milled into the housing 1. The drum 21, which is held in a rotatable manner in housing 1, comprises on its outside circumference a single groove 36 extending in the axial direction. The sound can enter the helical groove 35 through an inlet opening 38 and can exit the groove 36 of drum 21 through an opening 39. Both openings 38 and 39 are

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disposed in the face side 37 of the housing 1 or drum 21. Depending on the rotational position of the drum 21 the cross-over point 40 of the grooves 35 and 36 displaces and thus the length of the channel between the openings 38 and 39. As in the other embodiments, the cross sections of the channels 35 and 36 can be designed differently in order to form the inductivity on the one hand and the resistance on the other hand.

The present invention allows changing and optimizing the damping behavior of a hearing-protection device in a purposeful way depending on the respective requirements. The adjustment can be factory-set during production, which allows producing and offering a plurality of differently acting hearing-protection devices with one and the same device. Both production expenditure as well as expenditure for stock keeping can thus be reduced considerably. It is also possible to set the damping behavior during use in order to take changed ambient conditions into account. This allows a particularly flexible setting to the respective noise conditions in a particularly advantageous way.

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CLAIMS: (filed August 21, 2001)

1. A hearing protection device for damping sounds in a frequency-selective manner, comprising a housing which can be inserted into the external auditory canal of a person, in which a transmission path for sounds is disposed, consisting of at least one chamber (26) and at least one channel (11; 23a, 23b, 23c, 23d) with a predetermined cross-sectional progress which opens into said chamber (26), characterized in that a movable element is provided in which several different channels (11; 23a, 23b, 23c, 23d) are provided which are covered or released by a fixed housing part depending on the respective position.
2. A hearing-protection device as claimed in claim 1, characterized in that the movable element is arranged as a rotatable drum (21).
3. A hearing-protection device as claimed in claim 2, characterized in that the drum (21) is arranged within the chamber.
4. A hearing-protection device as claimed in claim 1, characterized in that several parallel channels are provided which are covered or released by the movable element.
5. A hearing-protection device as claimed in one of the claims 1 to 4, characterized in that the channel (23a, 23b, 23c, 23d) consists of three sections which are disposed one after the other, with the middle section (23a', 23b') having a smaller cross section than the other sections.
6. A hearing-protection device as claimed in claim 5, characterized in that several parallel channels (23a, 23b, 23c, 23d) are provided which substantially differ by the length (l) of the middle section (23a', 23b').

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7. A hearing-protection device as claimed in one of the claims 1 to 6, characterized in that a membrane (29) is provided in the chamber (30) transversally to the transmission path.
8. A hearing-protection device as claimed in one of the claims 1 to 7, characterized in that several chambers are disposed in parallel or behind one another in the transmission path.

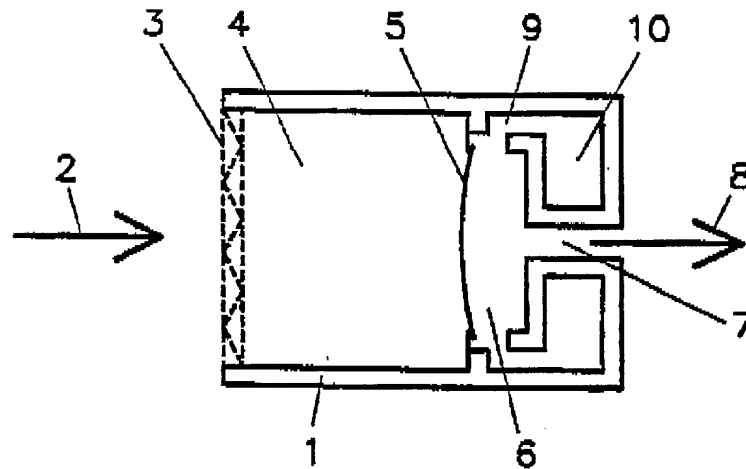
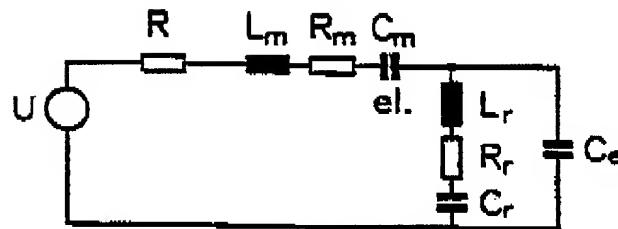
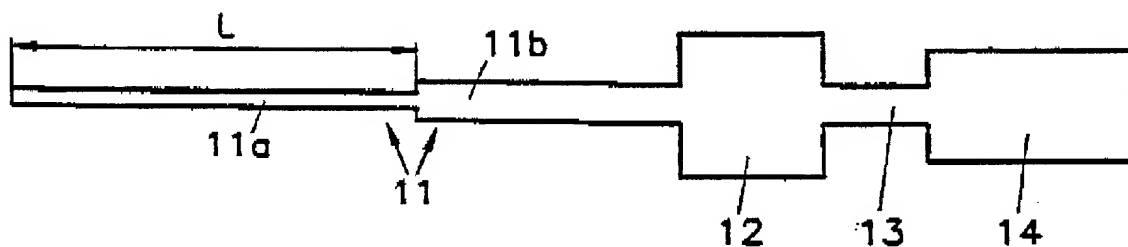
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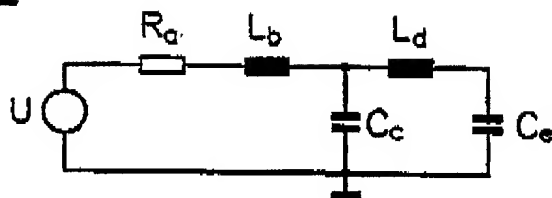
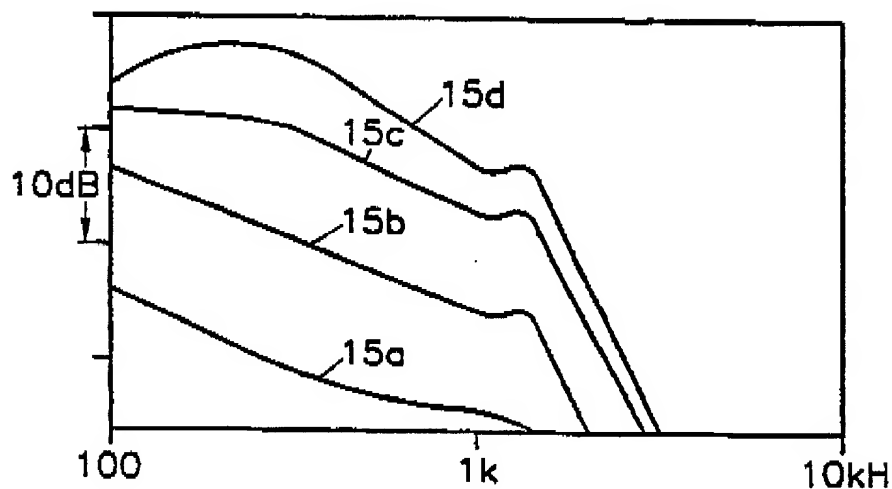
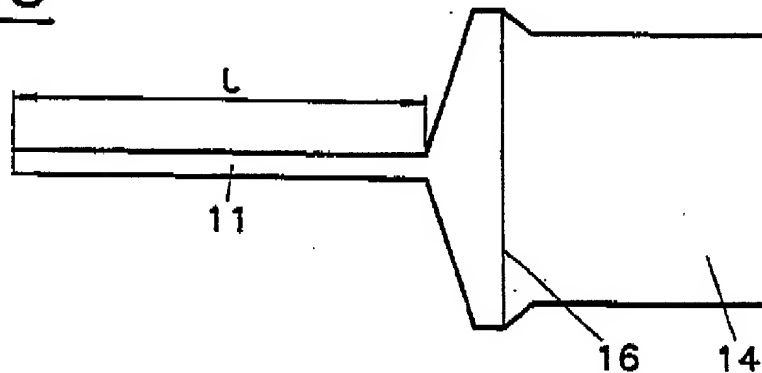
Fig. 1Fig. 2Fig. 3

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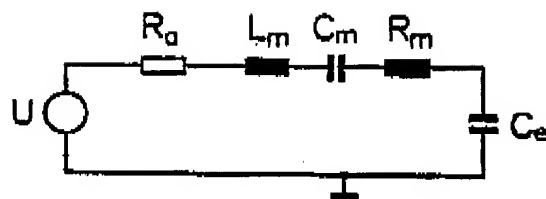
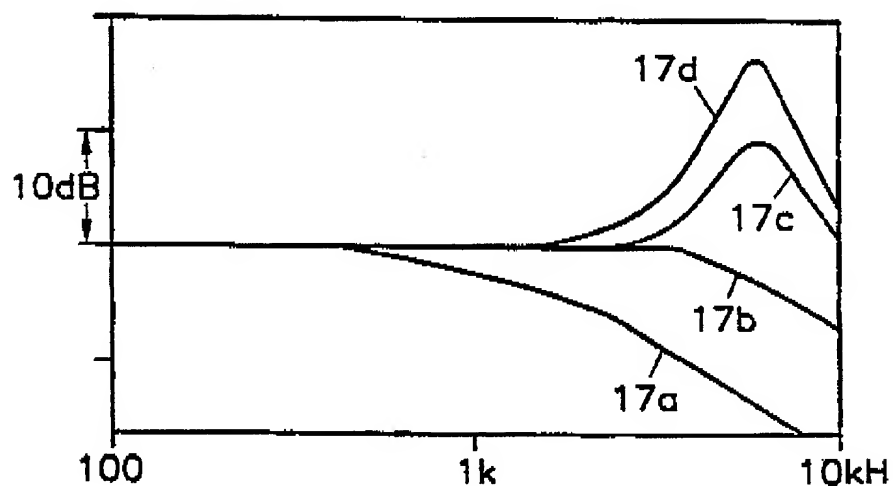
Fig.4Fig.5Fig.6

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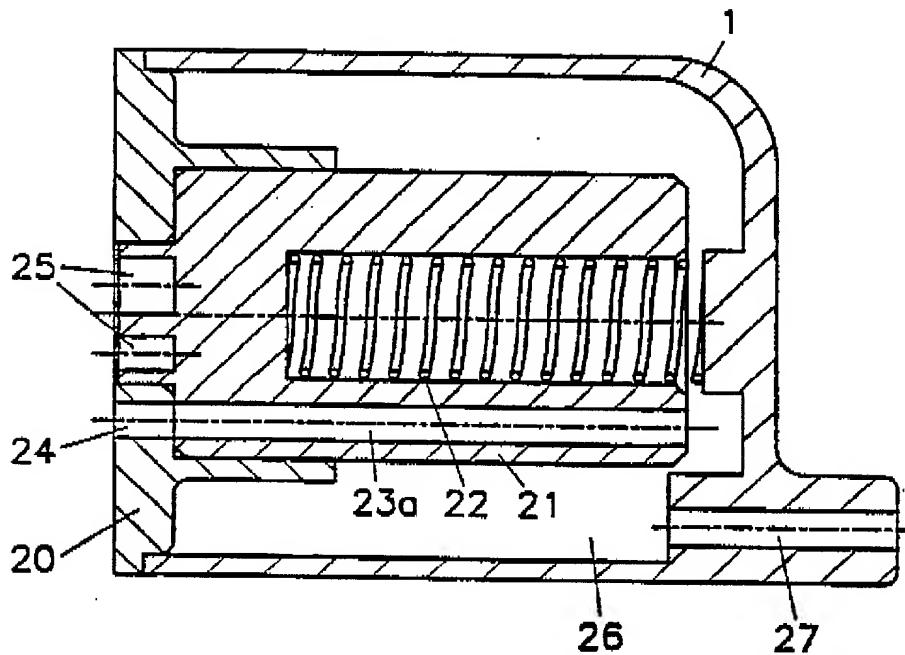
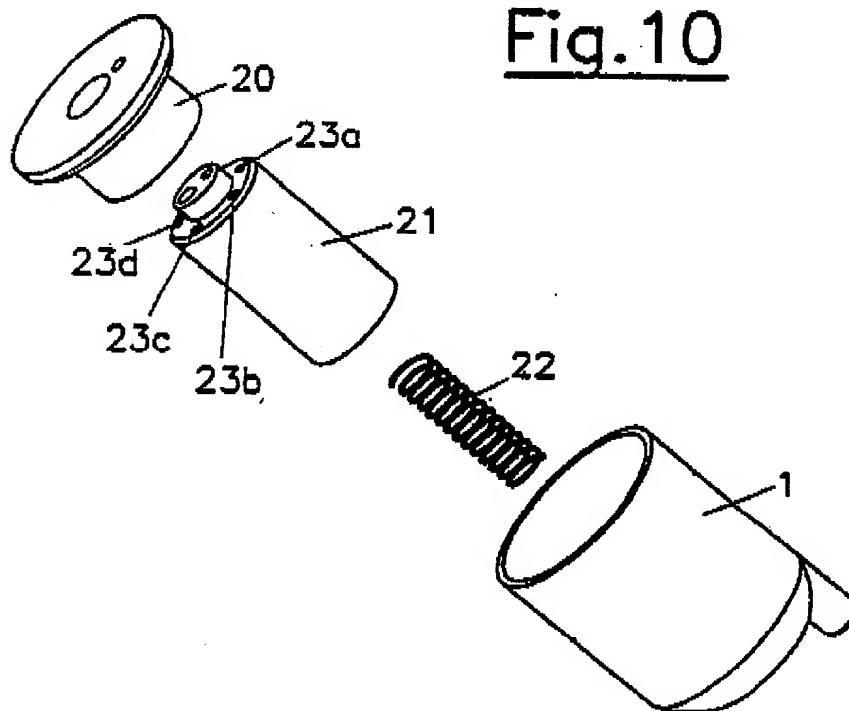
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Fig.7Fig.8

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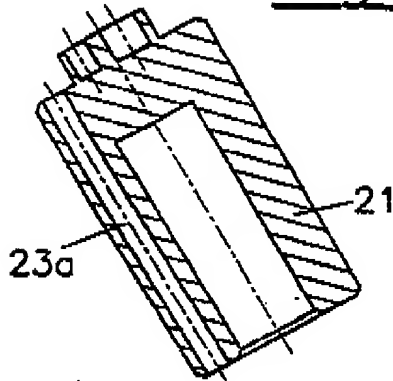
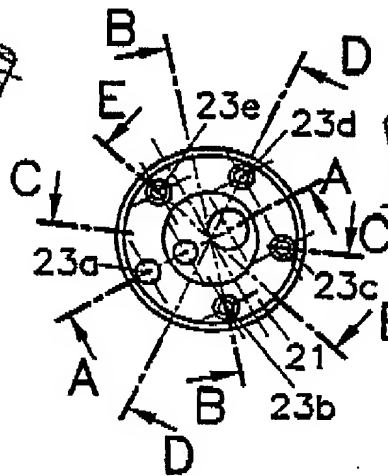
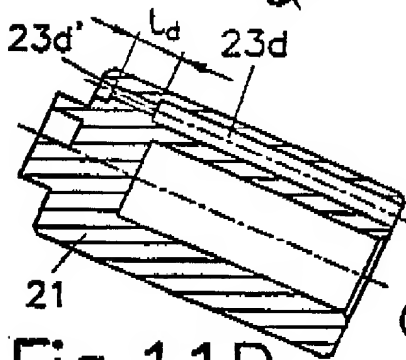
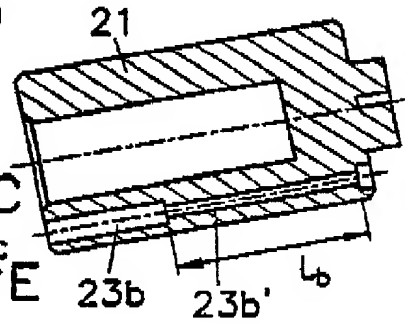
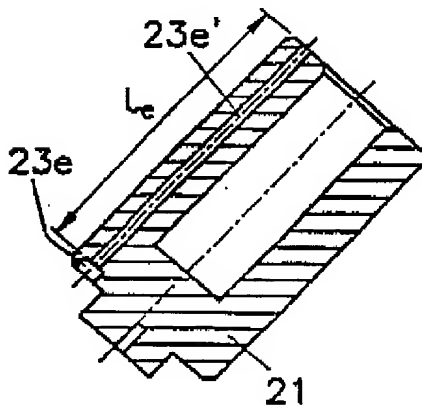
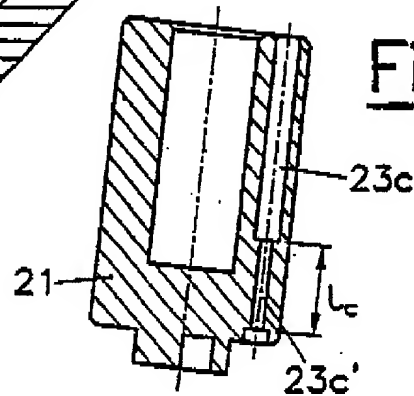
Fig.9Fig.10

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Fig. 11AFig. 11Fig. 11BFig. 11DFig. 11EFig. 11C

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Fig. 15

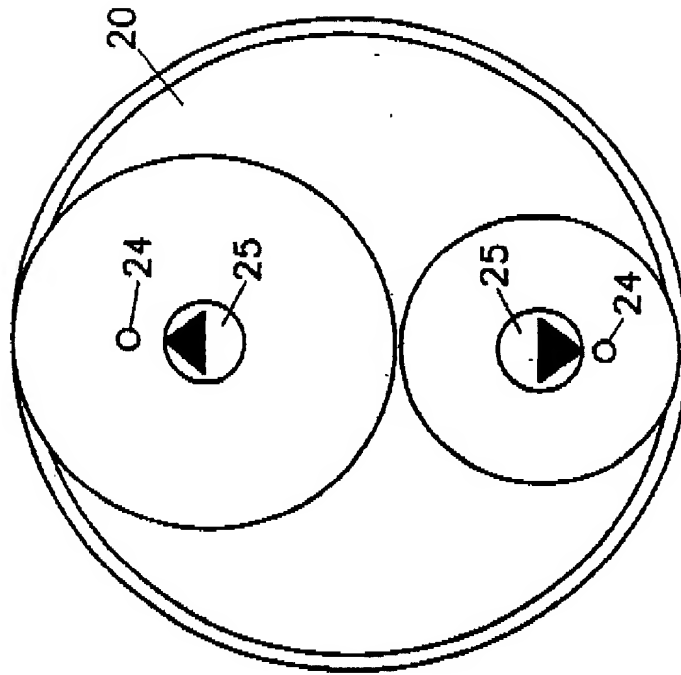
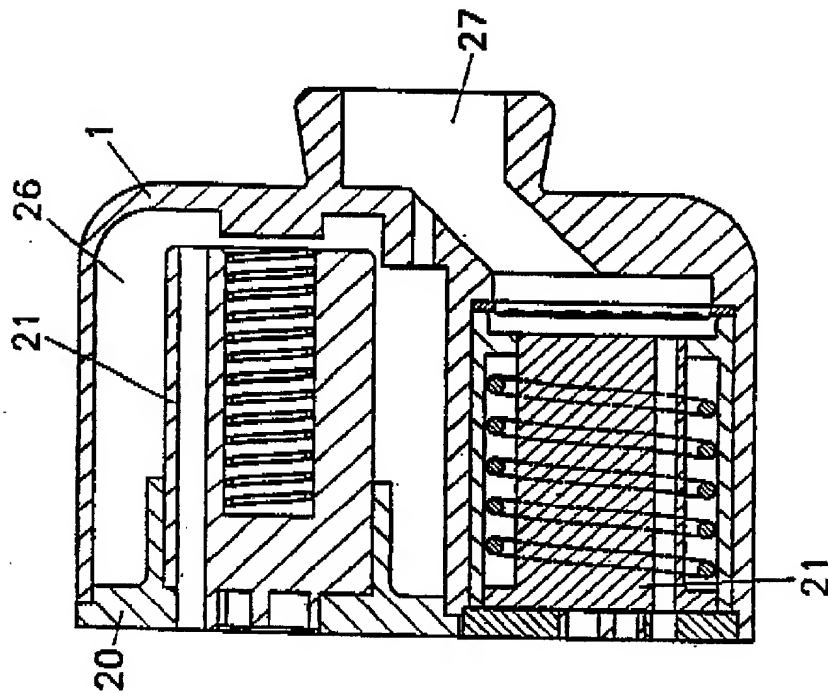


Fig. 14

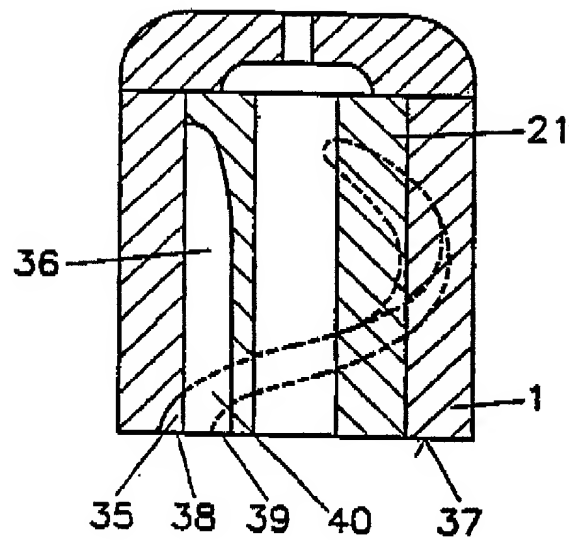


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Fig. 16

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**COMBINED DECLARATION AND POWER OF ATTORNEY
FOR UTILITY PATENT APPLICATION (Includes PCT)**
Attorney Docket No.

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name; that

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural inventors are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

HEARING-PROTECTION DEVICE

the specification of which (check one): ☒ [X] is attached hereto.

☐ [] was filed on _____ as Application Serial No. _____ and was amended on _____.

☒ [X] was filed as PCT international application no. PCT/AT00/00212 on 3. August 2000, and was amended under PCT Article 19 on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I do not know and do not believe the claimed invention was ever known or used in the United States of America before my or our invention thereof, or patented or described in any printed publication in any country before my or our invention thereof or more than one year prior to this application, that the same was not in public use or on sale in the United States of America more than one year prior to this application, that the invention has not been patented or made the subject of an inventor's certificate issued before the date of this application in any country foreign to the United States of America on an application filed by me or my legal representatives or assigns more than twelve months prior to this application.

I hereby claim foreign priority benefits under Title 35, United States Code §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application(s) on which priority is claimed:

Prior Foreign Application(s)

Priority Claimed

99890268.8
(Number)

EUROPE
(Country)

19. August 1999
Day/Month/Year Filed

☒ [X] ☐ []
Yes No

(Number)

(Country)

Day/Month/Year Filed

☐ [] ☐ []
Yes No

(Number)

(Country)

Day/Month/Year Filed

☐ [] ☐ []
Yes No

I hereby claim the benefit under Title 35, United States Code, §119 (e) of any United States provisional application(s) listed below:

Application No.

Day/Month/Year Filed

Application No.

Day/Month/Year Filed

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) or PCT international application(s) designating the United States of America listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior application(s) in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

Attorney Docket No. _____

Application Serial No. _____ Filing Date _____ Status (patented, pending, abandoned) _____

Application Serial No. _____ Filing Date _____ Status (patented, pending, abandoned) _____

I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith; Lawrence R. Radanovic, Reg. No. 23,077; Richard H. Tushin, Reg. No. 27,297; Donald N. Huff, Reg. No. 27,561; John P. DeLuca, Reg. No. 25,505; Michael Bergman, Reg. No. 42,318; Sandra S. Snapp, Reg. No. 41,444; Charles Rutherford, Reg. No. 18,933; Robert L. Kelly, Reg. No. 31,843; Kevin M. Hinman, Reg. No. 35,193; Ernest E. Helms, Reg. No. 29,721; William F. Kolakowski, Reg. No. 41,908; and John F. Buckert, Reg. No. 44,572, all of Dykema Gossett PLLC. Direct all telephone calls to telephone no. (202) 522-8600 and faxes to (202) 522-8669.

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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